

Circuit configuration for the voltage supply of a two-wire sensor

This invention relates to a circuit configuration for voltage supply of a two-wire sensor which is connected to a supply voltage source via a first connection line, in which a voltage longitudinal controller is positioned, and via a second connection line, in which the controller output is connected to the second connection line via a series circuit comprising at least two oppositely poled limiting diodes, and in which a current-limiting resistor is positioned in one of the two connection lines between the two-wire sensor and the series circuit comprising the limiting diodes.

A two-wire sensor is developed from a sensor element which measures a physical dimension, such as temperature, pressure or field strength of a magnetic field, as well as electronic components for processing signals supplied by the sensor element. Both the power supply and the conduction of the measured and processed measuring signals is effected only via two lines from which the name two-wire sensor is derived. Therefore, a two-wire sensor only has two connections which simultaneously serve to supply power and to conduct the measured and processed measuring signals.

Two-wire sensors, which are used in explosion-endangered areas, are equipped with a circuit configuration for current and voltage limiting—a so-called electrical barrier—to prevent explosions. To protect against overvoltages which might trigger potential ignition, the two connection lines are interconnected via at least one limiting diode. To protect the sensor against excessive currents which would cause the sensor to overheat, a series resistor is installed in the line after the limiting diode. To protect the limiting diode against excessive high voltages, a

voltage longitudinal controller, for example, is fit in the connection line, the output voltage of which during operation must always be smaller than the limiting voltage of the limiting diode.

Two-wire sensors, which are fitted with a so-called HART® interface, however, require a so-called HART® resistor of a prescribed value in one of the two connection lines leading from the supply voltage to the two-wire sensor. With a severely loaded two-wire sensor, this additional longitudinal resistor in one of the two connection lines may result in the supply voltage no longer being sufficient for flawless operation of the two-wire sensor.

Therefore, it is the object of the present invention to design a circuit arrangement for a voltage supply of a two-wire sensor such that, on the one hand, overvoltages and overcurrents are avoided with certainty, while, on the other hand, a sufficient supply voltage for flawless operation is always provided.

The foregoing object is achieved in the present invention by means of the features specified in Claim 1, in that the joint connection point of the two limiting diodes is connected to the control input of the voltage longitudinal controller.

The inventive measure, obtaining the regulating quantity for the voltage longitudinal controller from a pick-off of the series circuit of the limiting diodes acting as a voltage divider, has the advantage that the limiting voltage can be selected considerably smaller than with prior art electrical barriers. Because of the low limiting voltage, the longitudinal resistors, above all, the current-limiting resistor, in the connection lines from the supply voltage to the two-wire sensor can also be dimensioned smaller, so that the voltage loss—i.e., the voltage drop at the longitudinal resistors—caused by the supply current for the two-wire sensor is also reduced. Because of low voltage losses, the inventive circuit configuration, therefore, generates a higher

supply voltage than known electric barriers for the two-wire sensor, in spite of equal supply voltages.

The invention is explained in detail by means of the figures.

In the drawing:

Fig. 1 shows a block diagram of a first embodiment of the invention, and

Fig. 2 shows a block diagram of a second embodiment of the invention.

Fig. 1 shows a block diagram of a first embodiment of the invention.

One pole of a supply voltage source U is connected via a HART® resistor RH to the input of a voltage longitudinal controller SR, the voltage output of which is connected via a current-limiting resistor R1 to the input of a two-wire sensor S. The HART® resistor, the voltage longitudinal controller SR and the current-limiting resistor R1 are positioned in a first connection line V1, while the second pole of the supply voltage source U is connected to the other input of the two-wire sensor S via a second connection line V2. The controller output of the voltage longitudinal controller SR is connected to the second connection line V2 via a series circuit comprising two limiting diodes D1 and D2. The joint node of the two limiting diodes D1 and D2 is connected to the control input of the voltage longitudinal controller SR. The two limiting diodes D1 and D2 may be identically or oppositely poled.

If the voltage at the output of the voltage longitudinal controller SR exceeds the limiting voltage of the limiting diodes, a current flows through the two limiting diodes D1 and D2, so that the potential at the control input of the voltage longitudinal controller SR is pulled onto the

potential at the other pole of the supply voltage source U, which, for example, is grounded. The voltage longitudinal controller SR controls the voltage at its output and thus to a lower value, as a result of which the current through the two diodes D1 and D2 again drops to a residual current I which, however, is negligibly small. *not shown*

Fig. 2 shows a block diagram of a circuit configuration according to a second embodiment of the invention.

One pole of the supply voltage source U is connected to one input of a two-wire sensor S via a series circuit comprising a HART® resistor RH, the drain source path of a field effect transistor T1 and via a current-limiting resistor R1. The HART® resistor RH, the drain source path of the field effect transistor T1, and the current-limiting resistor R1 are positioned in a first connection line V1. The other pole of the supply voltage source U is connected to the other input of the two-wire sensor S via a second connection line V2. The source electrode of the field effect transistor T1 is connected to the second connection line V2 via a series circuit comprising two limiting diodes D1 and D2. Parallel to said series circuit, two additional series circuits of similar structure may be provided, each with two additional limiting diodes D3, D4, D5 and D6. The gate electrode of the field effect transistor T1 is connected to the source electrode via a resistor R2. Furthermore, the gate electrode of the field effect transistor T1 is connected via a resistor R3 with the collector of a transistor T2, the emitter of which is connected to the second connection line V2.

The points of connection of the limiting diodes D1 through D6 form a joint node which is connected to the base of the transistor T2. The series-connected limiting diodes D1 and D2, D3 and D4, as well as D5 and D6, may be identically or oppositely poled.

The function of the second embodiment shown in Fig. 2 corresponds to the first embodiment of Fig. 1. The field effect transistor T1 and the transistor T2 represent the voltage longitudinal controller SR. So long as no overvoltage occurs at the source electrode of the field effect transistor T1, the limiting diodes D1 through D6 block. As mentioned in the first embodiment, only the residual current I flows which, however, is negligibly small. If the voltage between the source electrode of the field effect transistor T1 and the second connection line V2 exceeds the limiting voltage, the limiting diodes D1 through D6 become conductive, so that a current flows through the first connection line V1 to the second connection line V2. Because the base of the transistor T2 is connected to the joint node of the limiting diodes D1 through D6, the transistor T2 becomes conductive, so that the gate electrode of the field effect transistor T1 is pulled onto the potential at the other pole of the supply voltage source U. As the field effect transistor blocks for this reason, the voltage between its source electrode and the second connection line V2 again drops below the value of the limiting voltage. Apart from the negligibly small residual current I, the limiting diodes D1 through D6 again become currentless, so that the transistor T2 again blocks, while the field effect transistor T1 again becomes conductive. By this means, one is able to control the supply voltage for the two-wire sensor S.

As mentioned above, the invention permits a much narrower limiting voltage than prior art electrical barriers, which allows a smaller current-limiting resistor. Because of the smaller current-limiting resistor R1, the inventive voltage losses are lower than with prior art electrical barriers. A comparison between the invention and a prior art barrier indicates that, with similar supply voltage sources, the invention provides for a greater voltage for the two-wire sensor. On

the other hand, with the invention with equal supply currents, a lower supply voltage suffices for the two-wire sensor.

3 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

List of reference symbols

D1 - D6 limiting diode

I residual current

RH HART® resistor

R1 current-limiting resistor

R2 - R4 resistor

S two-wire sensor

SR voltage longitudinal controller

T1 field effect transistor

T2 transistor

U supply voltage source

V1 first connection line

V2 second connection line

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